SCIENTIFIC NOTE

DOI: http://dx.doi.org/10.18561/2179-5746/biotaamazonia.v10n1p49-52

Predation of *Tropidurus oreadicus* (Reptilia, Tropiduridae) by *Heterophrynus* sp. (Arachnida, Phrynidae) in a cave in the Chapada das Mesas National Park, state of Maranhão, Brazil

Fábio Antônio de Oliveira[1], *Gabriel de Avila Batista*[2], *Karla Dayane de Lima Pereira*[3], *Lucas Gabriel Machado Frota*[4], *Victoria Sousa*[5], *Layla Simone dos Santos Cruz*[6], *Karll Cavalcante Pinto*[7]

1. Biólogo (Pontifícia Universidade Católica de Goiás, Brasil). Doutorando em Geologia (Universidade de Brasília, Brasil).
paleofabio@gmail.com http://lattes.cnpq.br/6651314736341253 http://orcid.org/0000-0001-8125-6339
2. Biólogo (Anhanguera Educacional, Brasil). Doutorando em Recursos Naturais do Cerrado (Universidade Estadual de Goiás, Brasil).
paleogenetica.gabriel@gmail.com http://lattes.cnpq.br/1131941234593219 http://orcid.org/0000-0003-4284-2591
3. Bióloga (Anhanguera Educacional, Brasil). Mestranda em Conservação de Recursos Naturais do Cerrado (Instituto Federal Goiano, Brasil).
karla.biologia@yahoo.com.br http://lattes.cnpq.br/4328373742442270 http://orcid.org/0000-0003-1578-8948
4. Biólogo (Pontifícia Universidade Católica de Goiás, Brasil). Analista Ambiental da Biota Projetos e Consultoria Ambiental LTDA, Brasil.
lucasgmfrota@gmail.com http://lattes.cnpq.br/7083829373324504 http://orcid.org/0000-0001-6907-9480
5. Bióloga (Pontifícia Universidade Católica de Goiás, Brasil). Mestranda em Ecologia e Evolução (Universidade Federal de Goiás, Brasil).
victoria182_@hotmail.com http://lattes.cnpq.br/0747140109675656 http://orcid.org/0000-0002-2818-5698
6. Bióloga (Centro Universitário de Goiás, Brasil). Especialista em Perícia, Auditoria e Gestão Ambiental (Instituto de Especialização e Pós-Graduação (IEPG)/Faculdade Oswaldo Cruz, Brasil).
laylasantos1113@gmail.com http://lattes.cnpq.br/3902005396931655 http://orcid.org/0000-0003-4655-7595
7. Biólogo (Centro Universitário de Goiás, Braisl). Mestrando em Conservação de Recursos Naturais do Cerrado (Instituto Federal Goiano, Brasil).
karllcavalcante@gmail.com http://lattes.cnpq.br/3845114585099468 http://orcid.org/0000-0001-7072-7262

ABSTRACT

In the area of the Chapada das Mesas National Park, south of the state of Maranhão, Brazil, the sandstone of the Sambaíba Formation (Triassic) predominate, demonstrating to be an area with potential for the occurrence of groundwater natural cavities. Cavernous ecosystems do not have vegetation cover and light (aphotic). Its trophic resources originate from external physical and biotic agents. The fieldwork found and identified 87 caves and evaluated its degree of relevance, including a biospeleological survey. During the effort, among the representatives of the cave fauna of the park, one of the most common was the amblypygids of the genus *Heterophrynus*, troglophiles animals, with representatives found in all the tropical and semitropical zones around the world. This group assumes a tertiary or secondary consumer role in the ecosystems where it occurs, with predation records ranging from arthropods to birds such as the hummingbirds (Aves, Trochilidae). One of the *Heterophrynus* records that deserves prominence, occurred in a cave which is in a region where the predominant vegetation of the surrounding area is the *Cerradão*. In this cavity, a trophic relationship of predation was recorded between an amblypygid from the *Heterophrynus* genus and a *Tropidurus oreadicus* lizard. The importance of registering for biodiversity is mainly related to the characteristics of the amblypygids, which makes up one of the orders of less diverse arachnids.

Keywords: Behavior; Amblypygi; Reptile; Conservation Unit.

Predação de *Tropidurus oreadicus* (Reptilia, Tropiduridae) por *Heterophrynus* sp. (Arachnida, Phrynidae) em uma caverna no Parque Nacional Chapada das Mesas, Maranhão, Brasil

RESUMO

Na área do Parque Nacional da Chapada das Mesas (PNCM), ao sul do estado do Maranhão, Brasil, predominam os arenitos da Formação Sambaíba (Triássico), demonstrando ser uma área com potencial para ocorrência de cavidades naturais subterrâneas. Os ecossistemas cavernícolas não possuem cobertura vegetal e luz (afóticos). Seus recursos tróficos são oriundos de agentes físicos e bióticos externos. O trabalho de campo encontrou e identificou 87 cavernas e avaliou seu grau de relevância, incluindo levantamento bioespeleológico. Durante o esforço, dentre os representantes da fauna cavernícola do parque, um dos mais comuns foram os amblipígios do gênero *Heterophrynus*, animais troglófilos, com representantes encontrados em todas as zonas tropicais e semitropicais ao redor do mundo. Este grupo assume papel de consumidor terciário ou secundário nos ecossistemas onde ocorre, com registros de predação que variam de artrópodes até aves como o beija-flores (Aves, Trochilidae). Um dos registros de *Heterophrynus* que merece destaque, ocorreu em uma caverna que está localizada em uma região onde a vegetação predominante do entorno é o Cerradão. Nesta cavidade foi registrada uma relação trófica de predação entre um amblipígio do gênero *Heterophrynus* e um lagarto *Tropidurus oreadicus*. A importância do registro para a biodiversidade está relacionada principalmente às características dos amblipígios, que compõe uma das ordens de aracnídeos menos diversas.

Palavras chave: Comportamento, Amblipígio, Réptil, Unidade de Conservação.

Caves are complex environments that present in rocky outcrops (INIESTA et al., 2012). These chambers harbor unique ecosystems, due to the unique characteristics they possess temperature, absence of light (aphotic zone) and vegetal cover (GANEM, 2009; INIESTA et al., 2012). Brazil owns approximately 4.200 caves (AULER, 2006). However, the country's cave fauna is still underestimated (SILVA et al., 2011). The main papers carried out are concentrated in the southeast, center-west and some in the northeast region (TRAJANO; GNASPINI-NETTO, 1990; MOTTA; PEÑA, 1999; AULER et al., 2003; LOBO; MORETTI, 2009; FERREIRA et al., 2010; TRAVASSOS; BETELLA, 2010; SILVA et al., 2011; INIESTA et al., 2012; SIMÕES, 2013). These sites are usually colonized by invertebrates of the orders Arachnida, Diptera, Neuroptera, Acarina, Hymenoptera, as well as some vertebrate species, such as fish, bats and amphibians (TRAJANO; GNASPINI-NETTO, 1990; WEYGOLDT, 2000; LEÃO et al., 2007; INIESTA et al., 2012). The colonization of this environment is deeply related to the allochthonous origin (generated from outside the cave) and availability of the trophic resources (CULVER, 1982; GANEM, 2009; FERREIRA et al., 2010; INIESTA et al., 2012).

In the Chapada das Mesas National Park (CMNP), located in an area of the Cerrado biome (Brazilian savannah) in southern Maranhão state, Brazil, the sandstone of the Sambaíba Formation (Triassic age) predominates, demonstrating to be an area with potential for the occurrence of underground natural cavities. Between 2012 and 2013 the outsourced environmental consulting company "Biota Projetos e Consultoria Ambiental Ltda" conducted a speleological survey in the CMNP (BIOTA, 2013). The study was carried out for the environmental diagnoses of the Estreito Hydroelectric Plant. The fieldwork found and identified 87 caves and evaluated its degree of relevance, including

Macapá, v. 10, n. 1, p. 49-52, 2020
Disponível em http://periodicos.unifap.br/index.php/biota
Submetido em 22 de Fevereiro de 2019 / Aceito em 06 de Outubro de 2019

a complete biospeleological survey.

In this note, we report a predatory trophic relationship between an adult amblypygid *Heterophrynus* sp. and a young lizard *Tropidurus oreadicus* that occurred in the CMNP. Our observations were made in cave MA46 (6º56'4" S; 47º23'5" W; 191 m a.s.l.), located in the CMNP area called "Porão do Farinha", in the municipality of Carolina (Figure 1). The vegetation around the cave MA46 is one of the types of the Cerrado biome called Cerradão. Compared to the other caves of CMNP, the MA46 was classified with low horizontal projection, being 3 m in length and the entrance is 60 cm high. Also, we found in this cave are spiders (*Sicarius* sp.), Crickets (*Laranda* sp.), cicadellids, the ants species *Camponotus rufipes*, *Crematogaster* sp., and *Paraponera clavata*, the Mamore robber frog (*Pristimantis fenestratus*), the common punaré (*Thrichomys* cf. *apereoides*), and Pallas's long-tongued bat (*Glossophaga soricina*).

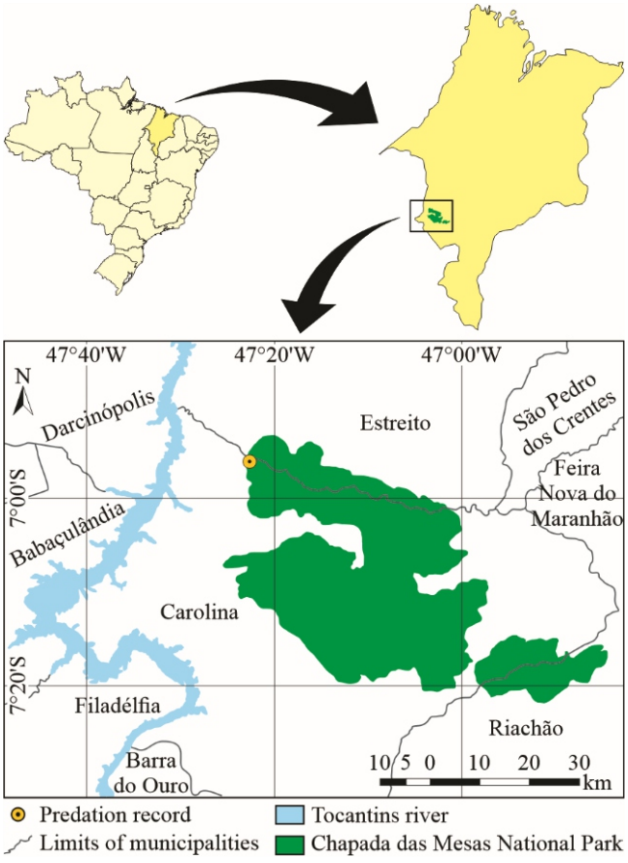

Figure 1. Local of the record obtained during the Speleological Survey in the Chapada das Mesas National Park, state of Maranhão, Brazil.

Amblypygids, also known as whip spiders and tailless whip scorpions, represent a group of chelicerate arachnids. To date, there are approximately 200 extant named species of amblypygids (MIRANDA et al., 2016a) with worldwide distribution, especially in the tropics and sub-tropics (WEYGOLDT, 2000). The illustration below shows the main parts of an amblypygid (Figure 2). Their bodies are broad and flattened dorsoventrally. They exhibit pincer-like chelicerae to grind and chew on their prey, cephalothorax (prosoma), pedicel, and segmented abdomen (opisthosoma). These invertebrates also have four pairs of legs. However, the first pairs of legs (Leg 1) are not used for locomotion because they are modified into thin antenniform legs with sensorial function for vibration and smell (WEYGOLDT, 2000; CHAPIN; HEBETS, 2016). Finally, amblypygids have a pair of modified pedipalps to capture and hold prey. They are called raptorial pedipalps and are armed with various spines that impale the prey (LADLE; VELANDER, 2003).

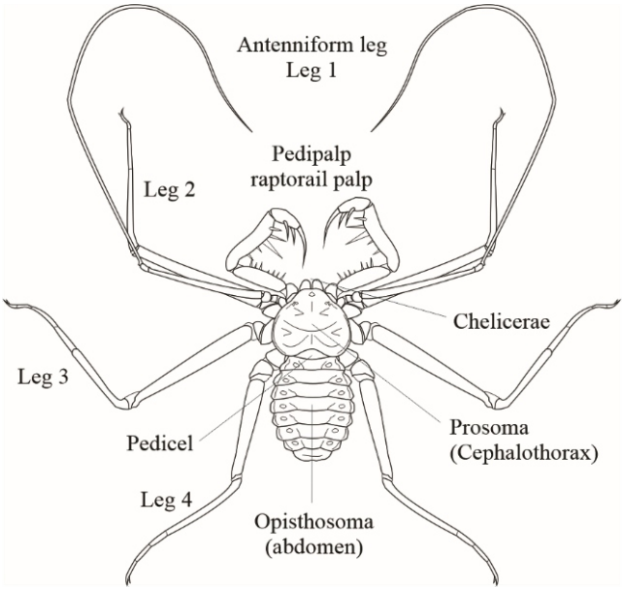

Figure 2. Dorsal view of amblypygid indicating main appendages. Like all arachnids, Amblypygi have four pairs of legs. Leg 1 is antenniform and used for communication and environmental detectability. Leg 2-4 used for walking. The raptorial pedipalps modified are armed with spines and are used to catch prey. The main body contain the pincer-like chelicerae to grind and chew, cephalothorax (prosoma), pedicel, and segmented abdomen (opisthosoma). Image is for illustrative purposes only based on the literature (WEYGOLDT, 2000; CHAPIN; HEBETS, 2016). Drawing by Oliveira, F. A. without scale.

The amblypygids of genus *Heterophrynus* Pocock, 1894 (Phrynidae) were commonly observed in the caves of CMNP (Figure 3a). The Phrynidae family inhabit the most diverse microenvironments, where they assume a secondary or tertiary consumer role (CHAPIN; HEBETS, 2016). Representatives of this family have a diverse diet, but mainly consume insects of the orders Orthoptera and Blattodea and, in some cases, practice cannibalism (WEYGOLDT, 2000; CHAPIN; HEBETS, 2016). Cases of predation or feeding of invertebrates have been reported in the literature as moths (HEBETS, 2002; CARVALHO et al., 2012), harvestmen, millipedes (HEBETS, 2002), crickets and katydids (HEBETS, 2002; CHAPIN, 2011; RAHMADI et al., 2010; PROUS et al., 2017), cockroaches (HEBETS, 2002; CHAPIN, 2015), spiders (HEBETS, 2002; CHAPIN, 2011; MIRANDA et al., 2016b), freshwater prawn (LADLE; VELANDER, 2003), scorpion (FORCELLEDO; ARMAS, 2014), centipede, isopods, booklice (MIRANDA et al., 2016b), termites (RODRÍGUEZ-CABRERA; TERUEL, 2016), and mollusk (TORRES et al., 2019). As for vertebrates, some cases have been reported as lizards of the genus *Anolis* (REAGAN, 1996; KOK, 1998), bats (RIVERA et al., 2009; PROUS et al., 2017), the Antillean crested hummingbird *Orthorhyncus cristatus* (OWEN; COKENDOLPHER, 2006), and the Cachabi robber frog *Pristimantis achatinus* (WIZEN; AZNAR GONZÁLEZ DE RUEDA, 2016).

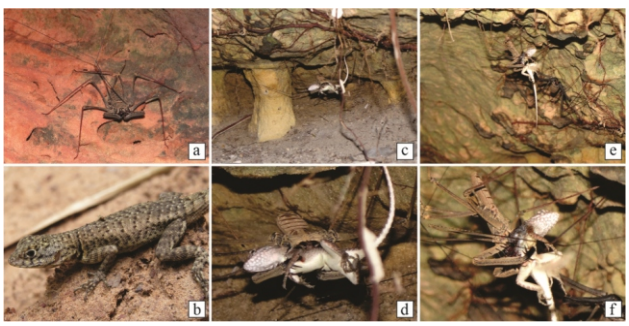

Figure 3. Examples of *Heterophrynus* sp., Arachnida, Phrynidae (**a**) and *Tropidurus oreadicus*, Reptilia, Tropiduridae (**b**) recorded in the caves of Chapada das Mesas National Park, state of Maranhão, Brazil. Original (**c**) and enlarged photo (**d**) of the capture register of *Tropidurus oreadicus* by *Heterophrynus* sp. in the cave MA46. Original (**e**) and enlarged photo (**f**) of *Heterophrynus* sp. feeding on *Tropidurus oreadicus* in cave MA46. Note in the original photo (**e**) the presence of another amblypygid. **Photos**: Oliveira, F. A.

The lizard *Tropidurus oreadicus* Rodrigues, 1987 (Tropiduridae) is common in the Cerrado biome (RODRIGUES, 1987) and generally abundant in open vegetation (COLLI et al., 1992; MEIRA et al., 2007; ROCHA; SIQUEIRA, 2008). Like amblypygids, *T. oreadicus* was also commonly observed in CMNP caves. However, no specimens were observed in aphotic areas. The records always occurred near the entrance of the caves, where there is the influence of light. They were observed in cracks or on rock surfaces (Figure 3b). This microhabitat is preferential by *T. oreadicus* and because of this, it is considered an animal of the saxicolous habit (MEIRA et al., 2007).

The predatory trophic relationship we found occurred on April 16th, 2013. We arrived at the MA46 cave early in the evening, around 6 pm. When we illuminate the interior of the cave, we saw 2 m from the entrance an adult *Heterophrynus* sp. with open pedipalps, very close to a young *Tropidurus oreadicus*. Young *T. oreadicus* was on a rock and *Heterophrynus* sp. it was on the cave wall, about 20 cm above. The adult amblypygid captured with its raptorial pedipalps the young lizard. Afterward, holding the lizard with its pedipalps, the amblypigid climbed onto the ceiling of the cave and into the deepest part. At this time the first photographic record took place at 6:04 pm (Figure 3c). The same enlarged photo shows the amblypygid holding the young lizard with the pedipalps (Figure 3d). He spent about 10 minutes just holding the young lizard and then began to feed. Neither our presence, the flashlights, or the camera's flash disturbed the amblypygid enough to make it stop eating. This same behavior was observed in an amblypygid feeding on a bat in a cave in Canaã dos Carajás, Pará state, Brazil (PROUS et al., 2017) approximately 195 miles (ca. 314 km) from the MA46 cave at CMNP. Subsequently, a second amblypygid appears and is close to the first amblypygid, which fed on the young lizard. The last photographic record was obtained at 07:25 pm. You can see the second amblypygid next to the first (Figure 3e). The same enlarged record shows in greater detail the amblypygid while feeding on the young *Tropidurus oreadicus* (Figure 3f).

After the last photographic record, amblypygid led the young lizard into one of the holes in the deepest part of the MA46 cave and disappeared. These holes can be seen in Figure 3c. It was not possible for the collection of the specimens due to the difficult access to the deepest part of the cave MA46, which is about 20 cm high. However, its species was identified by other biological samplings in the near cavities. All Tropiduridae specimens we collected were only *Tropidurus oreadicus*.

The amblypygids compose one of the orders of arachnids with less representation (CHAPIN; HEBETS, 2016). There are few records of the eating behavior of amblypygids in the literature and are still unknown to most species (WEYGOLDT, 2000; LADLE; VELANDER, 2003). As already mentioned, there have been records of amblypygid feeding on lizards (REAGAN, 1996; KOK, 1998). However, these records did not occur in caves. To date, the only records of vertebrates consumed by amblypygids in caves have been by bat necrophagy, with records in the Dominican Republic (ARMAS; ABREU-COLLADO, 1999 apud RIVERA et al., 2009), Cuba (RIVERA et al., 2009), and Brazil (PROUS et al., 2017). The 1999 Armas and Abreu-Collado record are the fir-st of bat necrophagy, but it was published in a local Dominican newspaper, with almost no scientific readiness. However, Rivera et al. (2009) reproduced the content in their paper.

The amblypygid ethology indicates basal levels of social behavior, tactile learning, recognition of individual characteristics, and intraspecific divergence of behavior (CHAPIN; HEBETS, 2016). Apparently, necrophagy may be a feature adopted by amblypygids in some situations (TORRES et al., 2019), as recorded in some caves. However, Chapin (2015) suggests behavioral variation in cave amblypygids, which were more vigilant and active in hunting. Another behavioral variation of hunting influenced by the environment was observed in amblypygids that immerse their antenniform legs in the water and await physical contact of the shrimps to hunt them with the raptorial pedipalps (LADLE; VELANDER, 2003).

The predation record of *Tropidurus oreadicus* by *Heterophrynus* sp. at CMNP is of great importance for biodiversity since it is mainly related to the characteristics of the amblypygids. Here we present the first record of amblypygid predation in Tropiduridae lizard, the first record of vertebrate predation in Brazil, and the first record of cave vertebrate predation. It also demonstrates how the group's diet is varied and helps to understand how species adapt to varying environments.

Acknowledgments

Acknowledges to Consórcio Estreito Energia - CESTE (www.uhe-estreito.com.br) and Biota Projetos e Consultoria Ambiental Ltda (www.biotanet.com.br) for logistical, financial and data support. The Lorena Alves e Silva for the geoprocessing.

References

AULER, A. S.; PILÓ, L. B.; SMART, P. L.; WANG, X.; NEVES, W. A.; CHENG, H.; EDWARDS, L. E. Cronologia e processos de deposição da megafauna quaternária em cavernas brasileiras. In: **Congresso da Associação Brasileira de Estudos do Quaternário-Abequa**, v. 9, p. 28, 2003.

AULER, A. Relevância de cavidades naturais subterrâneas: contextualização, impactos ambientais e aspectos jurídicos. **Ministério de Minas e Energia (MME)**, 2006.

BIOTA. 2013. Relatório Técnico Final da UHE Estreito: **Levantamento Espeleológico do Parque Nacional Chapada das Mesas**, 2013.

CARVALHO, L. S.; GOMES, J. O.; NECKEL-OLIVEIRA, S.; LO-MAN-HUNG, N. F. Microhabitat use and intraspecific associations in the whip spider *Heterophrynus longicornis* (Arachnida: Amblypygi) in forest fragments formed by the Tucuruí Dam lake, Pará, Brazil. **Journal of Natural History**, v. 46, n. 19-20, p. 1263-1272, 2012.

CHAPIN, K. J. **Ecology and natural history of the tree-inhabiting social amblypygid *Heterophrynus Batesii* (Butler 1873; Amblypygi: Phrynidae) in Eastern Amazonian Ecuador.** 2011. 61 f. Dissertação (Mestrado) West Texas A&M University, Canyon-Texas, 2011.

CHAPIN, K. J. Cave-epigean behavioral variation of the whip spider *Phrynus longipes* (Arachnida: Amblypygi) evidenced by activity, vigilance, and aggression. **Journal of Arachnology**, v. 43, n. 2, p. 214-219, 2015.

CHAPIN, K. J.; HEBETS, E. A. The behavioral ecology of amblypygids. **Journal of Arachnology,** v. 44, n. 1, p. 1-14, 2016.

COLLI, G. R.; ARAÚJO, A. F. B.; SILVEIRA, R.; ROMA, F. Niche partitioning and morphology of two syntopic *Tropidurus* (Sauria: Tropiduridae) in Mato Grosso, Brazil. **Journal of Herpetology**, v. 26, n. 1, p. 66-69, 1992.

CULVER, D. C. **Cave Life. Evolution and Ecology**. Cambridge, Massachussets and London, England: Harvard University Press, 1982.

FERREIRA, R. L.; PROUS, X.; De OLIVEIRA BERNARDI, L. F.; SOUZA-SILVA, M. Fauna subterrânea do Estado do Rio Grande do Norte: caracterização e impactos. **Revista Brasileira de Espeleologia**, v. 1, n. 1, p. 25-51, 2010.

FORCELLEDO, L. J.; ARMAS, L. F. Depredación de *Centruroides gracilis* (Scorpiones: Buthidae) por *Paraphrynus cubensis* (Amblypygi: Phrynidae). **Revista Ibérica de Aracnología**, n. 25, p. 97-98, 2014.

GANEM, R. S. A**s cavidades naturais subterrâneas e o Decreto nº 6.640/2008.** Brasília: Câmara dos Deputados, 2009.

HEBETS, E. A. Relating the unique sensory system of amblypygids to the ecology and behavior of *Phrynus parvulus* from Costa Rica (Arachnida, Amblypygi). **Canadian Journal of Zoology**, v. 80, n. 1, p. 286-295, 2002.

INIESTA, L. F. M.; ÁZARA, L. N.; SOUZA-SILVA, M.; FERREIRA, R. L. Biodiversidade em seis cavernas no Parque Estadual do Sumidouro (Lagoa Santa, MG). **Revista Brasileira de Espeleologia**, v. 2, p. 18-37, 2012.

KOK, P. *Anolis nitens chrysolepis* (goldenscale anole) predation. **Herpetological Review**, v. 29, n. 1, p. 41, 1998.

LADLE, R. J.; VELANDER, K. Fishing behavior in a giant whip spider. **Journal of Arachnology**, v. 31, n. 1, p. 154-156, 2003.

LEÃO, T. C.; LÔBO, D.; SILVA, E. J. Conservação, Geológica e Levantamento da fauna de invertebrados associados ao Guano da Caverna do Urubu (SE-10), Divina Pastora, Sergipe. **Direto do Centro da Terra**, v. 1, n. 1, p. 9-13, 2007.

LOBO, H. A. S.; MORETTI, E. C. Sustentabilidade ecológica do espeleoturismo na Serra da Bodoquena, Mato Grosso do Sul. **Revista Turismo em Análise**, v. 20, n. 1, p. 151-167, 2009.

MEIRA, K. T. R.; FARIA, R. G.; SILVA, M. D. M.; MIRANDA, V. T.; ZAHN-SILVA, W. História natural de *Tropidurus oreadicus* em uma área de cerrado rupestre do Brasil Central. **Biota Neotropica**, v. 7, n. 2, p. 155-164, 2007.

MIRANDA, G. S.; MILLERI-PINTO, M.; GONÇALVES-SOUZA, T.; GIUPPONI, A. P. L.; SCHARFF, N. A new species of *Charinus* Simon 1892 from Brazil, with notes on behavior (Amblypygi, Charinidae). **ZooKeys**, v. 621, p. 15-36, 2016a.

MIRANDA, G. S.; AHARON, S.; GAVISH-REGEV, E.; GIUPPONI, A. P. L.; WIZEN, G. A new species of *Charinus* Simon, 1892 (Arachnida: Amblypygi: Charinidae) from Israel and new records of *C. ioanniticus* (Kritscher, 1959). **European Journal of Taxonomy**, v. 234, n. 1, p. 1-17, 2016b.

MOTTA, J.; PEÑA, A. P. Fauna cavernícola da Lapa do Fuzil, Goianésia-GO In: **XXV Congresso Brasileiro de Espeleologia**. Vinhedo-SP, 1999.

OWEN, J. L.; COKENDOLPHER, J. C. Tailless Whipscorpion (*Phrynus longipes*) Feeds on Antillean Crested Hummingbird (*Orthorhyncus cristatus*). **The Wilson Journal of Ornithology**, v. 118, n. 3, p. 422-423, 2006.

PROUS, X.; PIETROBON, T.; RIBEIRO, M. S.; ZAMPAULO, R. A. Bat necrophagy by a whip-spider (Arachnida, Amblypygi, Phrynidae) in a cave in the eastern Brazilian Amazon. **Acta Amazonica**, vol. 47, n. 4, p. 365-368, 2017.

RAHMADI, C.; HARVEY, M. S.; KOJIMA, J. Whip spiders of the genus *Sarax* Simon 1892 (Amblypygi: Charinidae) from Borneo Island. **Zootaxa**, v. 2612, n. 1, p. 1-21, 2010.

REAGAN, D. P. Anoline lizards. In: REAGAN, D. P.; WAIDE, R. B. (Ed.). **The food web of a tropical rain forest.** Chicago: University of Chicago Press, 1996. p. 321-345.

RIVERA, L. G.; ESPÍN, R. M.; ARMAS, L. F.; HERNÁNDEZ, N. H. Necrofagia en Amblypygi (Arachnida: Pedipalpi). **Boletín Sociedad Entomológica Aragonesa**, n. 45, p. 505-507, 2009.

ROCHA, C. F. D.; SIQUEIRA, C. C. Feeding ecology of the lizard *Tropidurus oreadicus* Rodrigues 1987 (Tropiduridae) at Serra dos Carajás, Pará state, northern Brazil. **Brazilian Journal of Biology**, v. 68, n. 1, p. 109-113, 2008.

RODRIGUES, M. T. Sistemática, ecologia e zoogeografia dos *Tropidurus* do grupo *torquatus* ao sul do rio Amazonas (Sauria, Iguanidae). **Arquivos de Zoologia**, v. 31, n. 3, p. 105-230, 1987.

RODRÍGUES-CABRERA, T. M.; TERUEL, R. Distribution, conservation status and taxonomic update of the cuban endemic whip-spider *Charinus tomasmicheli* Armas, 2006 (Amblypygi: Charinidae). **Revista Ibérica de Aracnología**, n. 29, p. 67-74, 2016.

SIMÕES, L. B. **Biodiversidade da fauna subterrânea na área cárstica de São Domingos, nordeste de Goiás: relevância versus visibilidade de táxons.** 2013. 197 f. Dissertação (Mestrado) Universidade Federal de São Carlos/UFSCar, São Carlos, 2013.

SILVA, M. S.; NICOLAU, J. C.; FERREIRA, R. L. Comunidades de invertebrados terrestres de três cavernas quartzíticas no Vale do Mandembe, Luminárias, MG. **Espeleo-tema**, v. 22, n. 1, p. 155-167, 2011.

TORRES, R. A.; ARMAS, L. F.; TOVAR-MÁRQUEZ, J. Aspects of the natural history of *Phrynus barbadensis* (Pocock, 1893) (Amblypygi: Phrynidae). **Revista de la Sociedad Entomológica Argentina**, v. 78, n. 1, p. 12-21, 2019.

TRAVASSOS, L. E. P.; BATELLA, W. B. Espacializando a importância da caverna de Postojna (Postojnska Jama) para o turismo ao longo da história Eslovena. **Pesquisas em Turismo e Paisagens Cársticas**, v. 3, n. 1, p. 11-19, 2010.

TRAJANO, E.; GNASPINI-NETTO, P. Composição da fauna cavernícola Brasileira, com uma análise preliminar da distribuição dos táxons. **Revista Brasileira de Zoologia**, v. 7, n. 3, p. 383-407, 1990.

WEYGOLDT, P. Whip spiders (Chelicerata: Amblypygi): Their biology, morphology and systematics. **Denmark: Apollo Books**, p.163, 2000.

WIZEN, G.; AZNAR GONZÁLEZ DE RUEDA, J. *Pristimantis achatinus* (Cachabi Robber Frog). predation. **Herpetological Review**, v. 47, n. 3, p. 440-441, 2016.